COMPARISON OF APPLICATOR EXPOSURE TO AZINPHOS-METHYL USING ELECTROSTATIC AND CONVENTIONAL AIR BLAST SPRAYERS IN CALIFORNIA IN 1986

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SUMMARY

Workers were monitored during three pesticide applications of azinphos-methyl in almond orchards. One application used a conventional air blast sprayer and two applications used electrostatic sprayers. Data was collected on air concentrations and dermal exposure. Values calculated for total exposure were 5,319 ug/pound applied for the conventional sprayer and 960 and 962 ug/pound applied for the electrostatic sprayers. The results suggest a reduction in worker exposure with an electrostatic sprayer.

INTRODUCTION

Pesticide applicators are exposed to potential health risks of chemicals through dermal and inhalation absorption. Reducing the potential health risks by using application techniques that limit a worker's exposure is of primary concern. One technique of interest is the use of electrostatic sprayers. This sprayer uses an induction electrode opposite an air shear nozzle. The electrode is energized by a high voltage power supply resulting in induction charging of the droplets. Induction charging effects should produce smaller more uniform spray droplets, droplets that are more uniformly dispersed in the entrainment air with enhanced attractive and adhesion forces to the tree (Castle and Inculet, 1983). The effects allow for less volume being sprayed per acre and less spray fallout. To test the possibility that less spray fallout would result in less worker exposure, three exposure trials were monitored. One worker using a conventional air blast sprayer was compared to two workers using electrostatic sprayers. Direct measurements were used to estimate the worker's exposure to spray fallout. The total amount found in all gauze pads multiplied by appropriate body surface areas monitored plus the hand handwash was used to estimate spray fallout received by the worker.

MATERIALS AND METHODS

Monitoring was conducted on loader/applicators spraying azinphos-methyl on almond trees using normal application rates. Application rates were as follows:

Electrostatic	Conventional
1.4 pounds (active ingredient) per acre	1.5 pounds (active ingredient) per acre
25 gallons water	100 gallons water

The conventional sprayer (Arears) used standard type nozzles; the electrostatic sprayer (Windmill Electrostatic) used air shear nozzles and induction charging.

The method of Durham and Wolfe (1962) was used to monitor dermal exposure using 12-ply surgical gauze pads mounted in waterproof envelopes (foil-backed paper). The pads were mounted on the outside and under standard Tyvek^{R} coveralls worn by the workers. Pads were located on the arms, legs, chest, and back. The pads were placed under the coveralls so only one layer of the coverall material covered the pad.

Air concentrations were measured using portable personal sampling pumps set at a flow rate of one liter per minute. Glass fiber filters (37 mm diameter, 0.3 um pore size) were used as the sampling media followed by XAD-4 resin (two stage 40/80 mg sorbent tubes). The applicator wore the pump on his belt and the filter was clipped on his collar. Air pumps were calibrated before and after the exposure period with a Kurz Model 540S mass flow meter.

Handwash samples were taken using 400 milliliters of a solution containing 0.5 percent of a surfactant (Sur-Ten^{R}) in distilled water. The solution was poured into one-gallon plastic bags, and the applicator washed his hands inside the bag. This rinse solution was then poured into a glass jar.

All samples were stored frozen and analyzed by the California Department of Food and Agriculture, Worker Health and Safety Chemistry Laboratory Services. Information on analytical methods for each sample type can be obtained upon request.

RESULTS AND DICUSSION

Results of the three exposure periods monitored:

	Electrostatic Sprayer		Conventional Sprayer
Total Amount Micrograms	16,808	33,696	119,690
Pounds Azinphos-methyl Used	17.5	35	22.5
Hours Monitored	2.6	7	7
Micrograms/Pound Applied	960	962	5,319

The total amount is the sum of the results of the handwash and gauze pad samples outside and under the coveralls in ug/cm^2 multiplied by the appropriate body surface area. Body surface areas are taken from Popendorf and Leffingwell (1982). Table 1 reports the results of sampling by pad location in micrograms per square centimeter and handwash results. The only positive air concentration found was 0.033 micrograms per liter for the applicator using the conventional sprayer.

Oshita et al. (1986) compared dislodgeable foliar residues from a conventional air blast to an electrostatic sprayer and found initial residue levels three times higher for the electrostatic sprayer following application. Their data and the limited data collected here on worker exposure suggests that there is less spray fallout when applicators use electrostatic sprayers. Less spray fallout would reduce worker exposure.

Additional study is necessary to quantitatively evaluate the reduction in worker hazard provided by electrostatic sprayers. This technology appears to hold promise for significantly reducing applicator exposure.

References

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TABLE 1

Exposure Data by Pad Location
Micrograms Per Square Centimeter

	Electrostatic Sprayer				Conventional Sprayer	
	Under	Out	Under	Out	Under	Out
Back	0.055	2.14	0.22	1.72	0.072	6.82
Chest	0.177	0.669	0.04	8.50	0.219	9.64
Shoulder	-	1.79	-	-	-	-
Forearm	0.059	1.75	0.04	0.81	0.198	13.05
Thigh	0.065	0.526	0.01	3.49	0.080	16.71
Shins	0.034	1.69	ND	1.76	0.086	7.47
Pre-hand wash	96		148		45.2	
Post-hand wash	1226		463		246	

ND - none detected
Minimum detectable level 0.5 ug/sample